Connecting the Sun and the Solar Wind: Longitudinal Variations of Density and Velocity

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Using polarized brightness (pB) measurements made by the High Altitude Observatory (HAO) Mk III K-coronameter, we examine the longitudinal variations of path-integrated density at 1.15 Ro for latitudes higher than 40 degrees in 1993/1994. We show that both the polar coronal hole and neighboring quiet Sun are characterized by factor-of-two variations in pB. Since the average pB level of polar coronal holes is half that of the quiet Sun, polar coronal holes are marked by longitudinal variations that are only half as large as those in the quiet Sun. However, the nature of the longitudinal variations is the most conspicuous feature distinguishing quiet Sun from polar coronal hole. Representing mainly longitudinal structure but also temporal change, the longitudinal variations change abruptly from recurrent in the quiet Sun to non-recurrent in the polar coronal hole across the coronal hole boundary. These distinct morphological properties of coronal density are strikingly replicated in the solar wind measurements made by Ulysses in 1993/1994, thus adding significantly to the growing body of evidence supporting the radial extension of polar coronal holes into the solar wind. When point-to-point comparisons are made between the daily Mk III and Ulysses high-latitude measurements, we find that, while the details of the longitudinal structure in the solar corona do not survive to the distances of Ulysses, their consequences in the form of interaction regions are observed in the high latitude solar wind. The strongest interaction regions in the fast wind are produced when the fast wind from the polar coronal hole (approximately 800 km/s) runs into the slower fast wind from the quiet Sun (approximately 700 km/s) ahead of it. We also show that the weaker high latitude interaction regions observed by Ulysses in 1995/1996 are a result of correspondingly smaller longitudinal variations in pB at the Sun during that time.